



Testimony of Jeffrey R. Lyng  
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Boulder, Colorado

On Behalf of the  
University of Colorado

Before the  
Subcommittee on Energy  
U.S. House of Representatives

*"Winning Teams and Innovative Technologies from the 2005 Solar Decathlon"*

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Madam Chairman and Members of the Subcommittee on Energy:

On behalf of the University of Colorado College of Architecture & Planning and College of Engineering and Applied Science, I would like to thank you for the opportunity to speak with you today.

I would like to acknowledge the U.S. Department of Energy, the National Renewable Energy Laboratory, and each of the contest sponsors for their work in fostering the Solar Decathlon and their commitment to improving the future of energy. Most importantly, I would like to recognize all of the 2005 Solar Decathlon teams, especially those not represented here today, for their unwavering dedication to solar energy.

I am here today to give you a fresh perspective as a young professional in the renewable energy industry, but more importantly as fellow Solar Decathlete. I'm here to tell the story of a new generation of solar patriot.

For student competitors, the Solar Decathlon offers a learning experience rarely seen in academia. These design/build projects are training a highly skilled workforce able to do more with less. The Solar Decathlon embodies much more than job training, however. It symbolizes a sincere effort on the part of students, teachers, industry professionals and government leaders to solve some of the most immediate energy production problems facing our world. Furthermore, it symbolizes the empowerment of a new generation.

I could continue on with accolades about the competition and describe for you how powerful it was to participate in a demonstration of solar energy during a week of overcast weather or how inspiring it was to see over 120,000 visitors on the National Mall. But that's not why we're here. We are here because we acknowledge the potential of the Solar Decathlon competition to spark innovation, ingenuity, and change. We also recognize that the competition can be improved. Through mutual collaboration and our discussion here today I hope that we can tailor this competition to more closely address the mounting concerns of energy cost and reliability that the mainstream home owner is faced with every day.

Having devoted the past three years of my life to the CU Solar Decathlon Project and spoken with thousands of people who toured the CU Bio-S(h)IP during the week of the competition, I am excited to participate in your efforts to strengthening it. I would like to share with you three personal observations from my experiences which address the questions outlined for our discussion and offer solutions within the context of the Solar Decathlon competition.

**1. Some visitors undoubtedly walked away from the competition misinformed about solar energy.**

For many members of the public, the Solar Decathlon was their first introduction to solar energy. This mis-information was not due to a lack of knowledge or enthusiasm on the part of Solar Decathletes. It was the result of a fundamental flaw of the competition; the need to be off-grid.

For many visitors, their impressions of solar technology from touring the homes are that it requires huge battery banks, should cover every square foot of your roof and probably requires hiring someone to staff your mechanical room 24/7 to operate it. I believe that transitioning the competition from a stand-alone application to a grid-tied application with smaller arrays, little if any on-site energy storage and net metering on each house can only result in homes more closely aligned with what the typical consumer can actually expect to live in.

I am exceedingly proud of the CU Team for winning the Communications contest. We invested thousands of hours into streamlining our messaging to the public, yet that message was still sometimes misconstrued. We must fix this problem of grid interconnectedness before the 2007 event if the public is to comprehend the true merits of solar energy or else run the risk of leaving the wrong impression.

**2. While the competition is a great showcase for individual technologies and products, it is not a great showcase of integrated building approaches.**

I'd like to share with you my experiences this past week. Shortly after returning to Colorado from the Solar Decathlon competition, I spent three days at a builder conference well attended by many production home builders. I felt like I'd gone from one end of the residential building spectrum to another. It could be argued that the CU Solar Decathlon house is perhaps the most custom home in the State of Colorado right now, and likewise for each of the other homes in their respective states. In the design process, we pushed the last percentage point of efficiency for maximum energy production. Contrast that with the production home market in which an unfortunate number of products are right now being designed and built all around the country with no regard to the benefits of an east-west solar orientation or the advantages of building homes even slightly above current energy code.

It is tragic to think that none of the 18 homes that were showcased on the National Mall last month might ever be built again. There exists an inherent and ever-widening disconnect between the homes Solar Decathletes give form to and the realities of the production home market in the US. I believe that the competition falls short of offering real solutions to how these homes can be incorporated into the large subdivisions. We must find ways to facilitate energy

efficient and solar technology transfer from the Solar Decathlon competition to the production home market if we aspire to appeal to the average home buyer.

### **3. The true economic viability of each home is not well understood.**

Perhaps the biggest surprise for me through this entire process was how much of my time was consumed by fundraising. There was talk of “pulling the plug” this spring and a very real concern that the defending champions would not be able to compete due to lack of funding.

The CU Solar Decathlon Team’s budget for the 2005 project was \$500,000. Assuming a comparable budget for all teams in 2007, the \$100,000 pledge to each competing university from the DOE leaves a substantial 80% cost sharing on the part of the students participating. That level of fundraising can distort design.

Alleviating the burden of fundraising would have several positive ramifications.

1. It would increase the quality of each design by allowing teams to devote more time to the design and construction phases, rather than fundraising.
2. It would ensure a more objective approach to showcasing only the best technologies, rather than simply those products that teams are able to secure donations for.
3. It would provide a means for accurate accounting of the true retail cost of the each home by eliminating the guess work associated with product donation.

I also recommend abandoning the *Energy Balance* contest for a *Life-Cycle Cost* contest in which teams compete to build the least expensive home to construct and operate. This would be very possible under a net-metering scenario.

The Solar Decathlon competition must not be perceived as a novelty or political distraction. It must play a supporting role in creating a new future of energy use if we are to achieve what Richard Nixon was referring to in 1973 when he said, “Let us set as our national goal, in the spirit of Apollo, with the determination of the Manhattan Project, that by the end of this decade we will have developed the potential to meet our own energy needs without depending upon any foreign energy source.”

Thirty years later, we can all agree that we didn’t make it. But why didn’t we make it? We didn’t get to the Moon by encouraging college students to build bottle rockets on the National Mall.

Achieving energy independence will take more than just collaborative efforts on the part of students, builders, researchers, and policy makers to bring to fruition. It will take federal leadership beyond these collaborations to make it happen.

Each Solar Decathlete is doing their part in keeping the candle lit for solar energy. It is now time for members of this committee and all members of congress to lead the way in carrying the torch.

Thank You

## **Key Features of the 2005 University of Colorado Solar Decathlon House; The Bio-S(h)IP**

- Revolutionary Bio-SIP, or bio-based Structural Insulated Panel, wall panels composed of soy-based polyurethane insulation and fully recycled post-consumer waste paper board.
- A single-chassis design, reinventing the “solar mobile home” for the 21<sup>st</sup> century.
- A 6.8 kW photovoltaic (PV) array comprised of 34 SunPower SPR-200 watt panels with an efficiency of 16.1% (among the highest in the industry).
- Building integrated photovoltaic (BIPV) array to serve as shading devices over south façade windows.
- Evacuated-tube solar thermal collectors that supply over 80% of space heating and hot water needs.
- High-efficiency, ductless air conditioning units.
- Radiant in-floor heating system with innovative controls for energy efficiency and improved comfort.
- Translucent double-skinned polycarbonate clerestory windows filled with high-insulation hydrophobic silica gel powder.
- Low-e, double-paned windows with attractive fiberglass frames that boast an R-14 COG (center of glass) value.
- An energy recovery ventilator (ERV) to provide efficient ventilation, heat recovery and air filtration.
- Low-power, high-performance kitchen appliances including a combination washer/dryer, an induction stovetop, a high-insulation refrigerator, and a combination microwave and electric convection oven.

Please refer to the Bio-S(h)IP User Manual (attached) for a more detailed overview of the key features in the 2005 University of Colorado Solar Decathlon House.

**1. Given your experience, what do you think are the main technical and other barriers to greater use of solar energy? Do you have any suggestions for what might be done to overcome those barriers? How do you see the competition itself as helping to move both solar and efficiency technologies into the mainstream building market?**

I believe that there remain technical, educational, institutional and financial barriers to greater market penetration of solar energy.

Technical barriers

There is ample research yet to be done to increase efficiencies; reduce up-front costs and increase integration.

Educational barriers

Currently in the US, there are only a handful of universities that offer degree programs in renewable energy. I discovered the Building Systems Program at the University of Colorado at Boulder through the DOE Solar Decathlon website on the 2002 event.

Institutional barriers

There exists an inherent and ever-widening disconnect between the homes Solar Decathletes give form to and the realities of the production home market in the US. I believe that the competition falls short of offering real solutions to how these homes can be incorporated into the large subdivisions. We must find ways to facilitate energy efficient and solar technology transfer from the Solar Decathlon competition to the production home market if we aspire to appeal to the average home buyer

In addition, partnership with existing government programs and national laboratories is crucial. For example, none of the 2005 Solar Decathlon Teams partnered with the DOE Building America Program.

Financial barriers

The CU Solar Decathlon Team's budget in 2005 was approximately \$500,000. DOE funding to each team will increase from \$5,000 in 2005 to \$100,000 in the 2007 event. At a sponsorship level of \$100,000, the DOE is essentially requesting an 80% cost share from all of the participating universities. This is a substantial amount of funding for undergraduate and graduate engineers and architects to raise in a 12 to 18 month period. It is certainly not enough time to forge the type of partnerships with sponsors that are likely to donate at higher levels.

Increasing the funding level to \$250,000 per team (an approximate cost share of 50%) would have several positive ramifications on the competition.

- It would increase the quality of each design by allowing teams to devote more time to the design and construction phases, rather than fundraising.
- It would ensure a more objective approach to showcasing only the best technologies, rather than simply those products that teams are able to secure donations for.
- It would provide a means for accurate accounting of the true retail cost of the each home by eliminating the guess work associated with product donation.



**2. What sources of information did you draw on to figure out how to build your house? What problems arose in designing or constructing your house that surprised you?**

The University of Colorado won the Documentation contest in what one judge referred to as a “Tour de Force” approach. The CU Team’s principle resources were the professors and faculty advisors from both colleges. Team members developed expertise along the way to perform necessary energy modeling and thereby take advantage of the resources available on campus. A wealth of design tools were used by the CU Team through the schematic design phase. For example, six separate design tools were used to model the active and passive solar systems alone in the CU house. This is a testament to the need for further integrated design tools. A trial and error approach to extensive energy simulation dictated the final design from an engineering perspective. The CU Team submitted an exhaustive Schematic Energy Analysis Report early in the design process to organizers at the National Renewable Energy Laboratory.

Perhaps the biggest surprise for me through this entire process has been how much of the entire CU Team’s time was consumed by fundraising. Unfortunately, this time would have been better spent concentrating on the design, construction and commissioning phases of the project.

### **3. Would your house be commercially viable? If not, what changes would make it more attractive to the mainstream home buyer?**

The CU Team worked with the largest manufactured home builder in the nation, Genesis Homes, for the design and construction of the chassis used to transport the Bio-S(h)IP. In addition, the CU Team worked with a client, Prospect New Town (a new-urbanist development in Longmont, Colorado), for the pre-purchase of the home. Further incorporation of the manufactured home process will inevitably drive the retail construction cost of the Bio-S(h)IP down. In addition, all of the products used in the CU house are commercially available today.

Having one of the longest over-land distances to travel to the competition, CU Bio-S(h)IP was principally driven in design by the need to transport it thousands of miles. The average home owner will never move their home anywhere, much less thousands of miles. There is an inherent contradiction here. The mainstream home buyer is not interested in a product that is driven architecturally by the need for mobility. The Bio-S(h)IP was designed in cooperation with a specific client and for the unique purpose of being transported over long distances. For this reason, rather than suggest changes to the Bio-S(h)IP that would render it more attractive to the mainstream market, I offer suggestions for how to tailor future Solar Decathlon competitions in a way that will render the finished products more appealing to the average home buyer.

#### *1. Re-examine the merit of an 800 square foot limitation.*

There are many applications for 800 square foot solar-powered buildings; low-income housing, developing world and war-torn area aid relief, and Native American reservations. These are not mainstream home buyer applications, however. According to the National Association of Home Builders, the average size of a homes purchased in the US is now 2,200 square feet.

#### *2. Consider a grid-tied application including net-metering.*

Establishing a mini grid for the Solar Village our enabling each team to tie into the local electrical grid would accommodate smaller PV arrays and battery bank sizes and would also give the general public a truer sense of what living with solar would be like for them.

#### *3. Exchange the Energy Balance contest for a Life-Cycle Cost contest.*

The cost of construction and operation is of far greater interest to the average home buyer than is the concept of energy balance. With a more diligent accounting of the cost of construction and a net-metering scenario, teams could conceivably compete for the lowest life-cycle cost.

**Jeff Lyng** holds a B.S. in Ecology from SUNY-ESF and is presently completing a Master's of Civil Engineering with a focus in renewable energy in the Building Systems Program at the University of Colorado. He was instrumental in founding the University of Colorado Renewable Energy Club (CURE) and also serves on the Board of Directors for the Colorado Alliance for a Sustainable Future (CASF) as the CU student group liaison. Jeff's masters project will focus on the implementation of Colorado Amendment 37's residential solar set-aside provision in the new home market through existing residential green building programs. He currently serves as the Project Manager for the 2005 CU Solar Decathlon Project and as the Built Green Specialist for the Metro Denver Home Builders Association.